

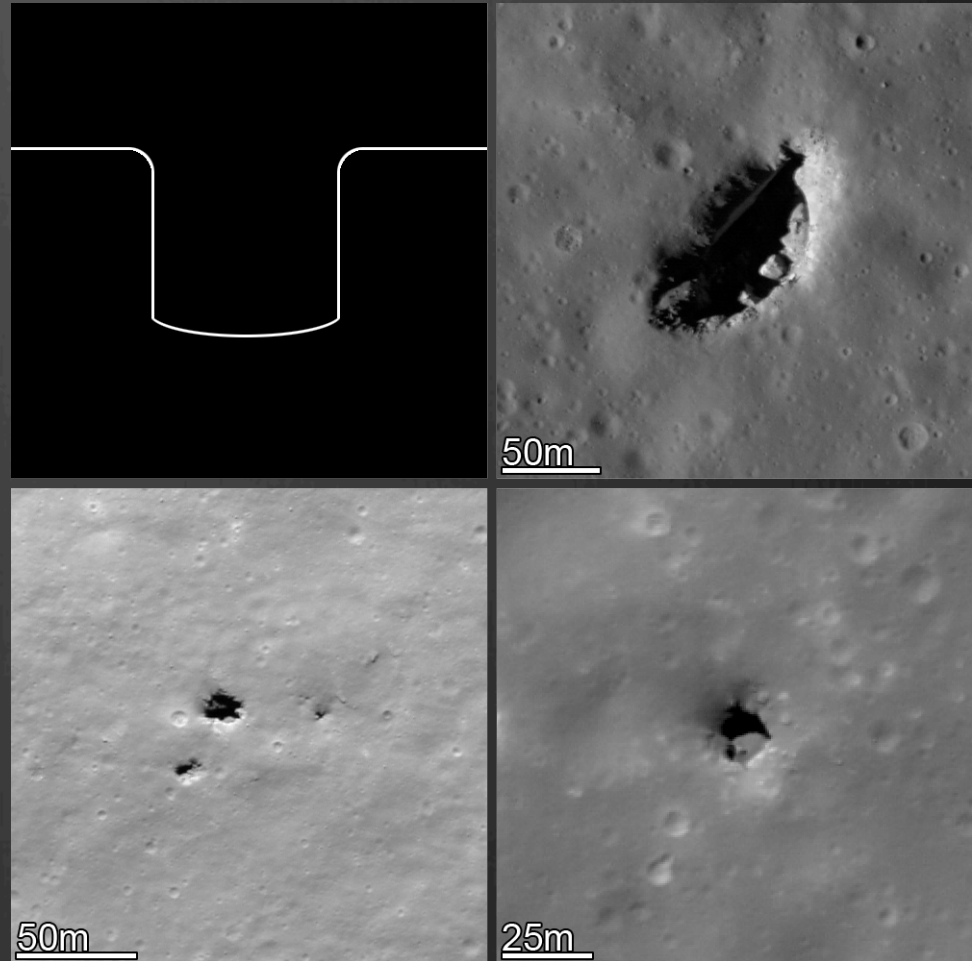
Overview

Spatial Distribution of Pits in Impact Melts

- Impact melt deposits are full of holes
 - 169 pits with diameters $>5\text{m}$ in 25 craters
 - Median depths 10m , median diameter is 15m
- Defining “pit” Robert Wagner, Mark Robinson
- Prior work
- Case studies (Copernicus, Stevinus, Lalande)
- Interpretation
 - Impact melt moves after initial emplacement
 - Pits provide access to subsurface void spaces

What is a pit?

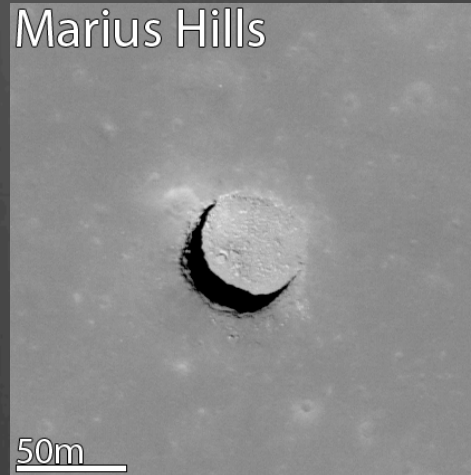
- ⊗ Vertical walls
- ⊗ Flat or slightly concave floor
- ⊗ Most of depth is from walls, not concave floor
- ⊗ Often elliptical, with inward-sloping rim
- ⊗ Not along a fracture
- ⊗ No genetic implications are intended by the term “pit”



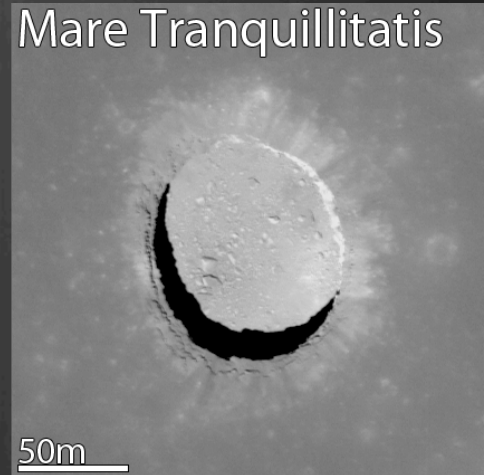
Previous Work: Mare Pits

- ❁ Haruyama 2009
 - ❁ First discovered the three known large mare pits
- ❁ Robinson 2012 (PSS)
 - ❁ Showed that there are void spaces / overhangs
- ❁ LROC recently imaged a fourth mare pit, much smaller than the first three

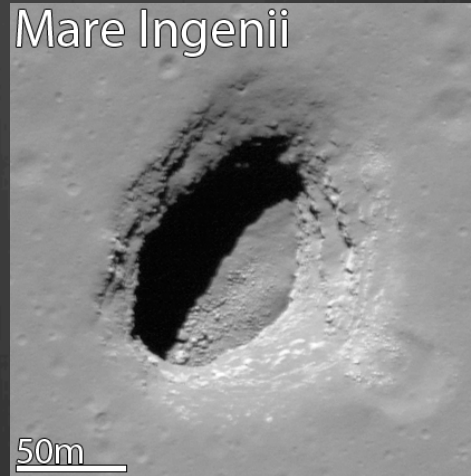
Marius Hills



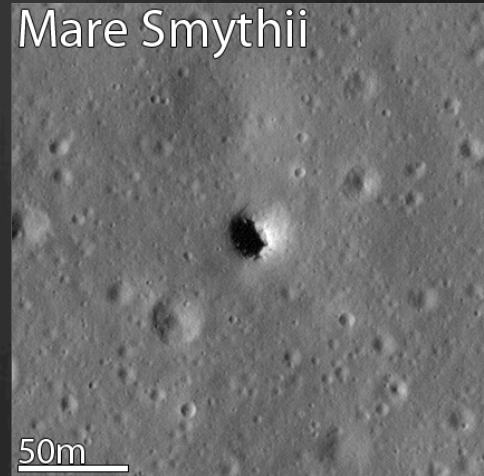
Mare Tranquillitatis



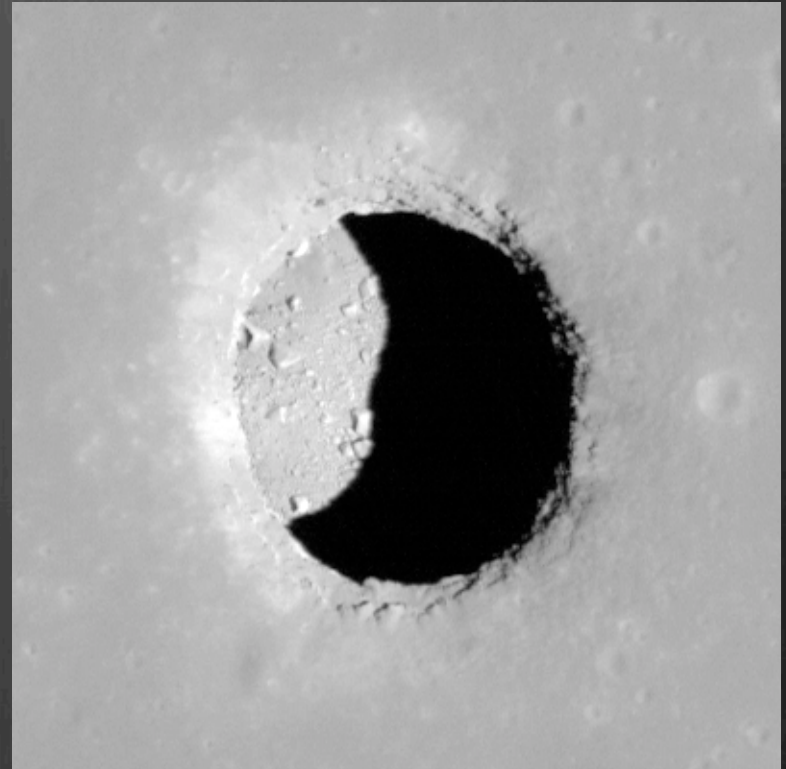
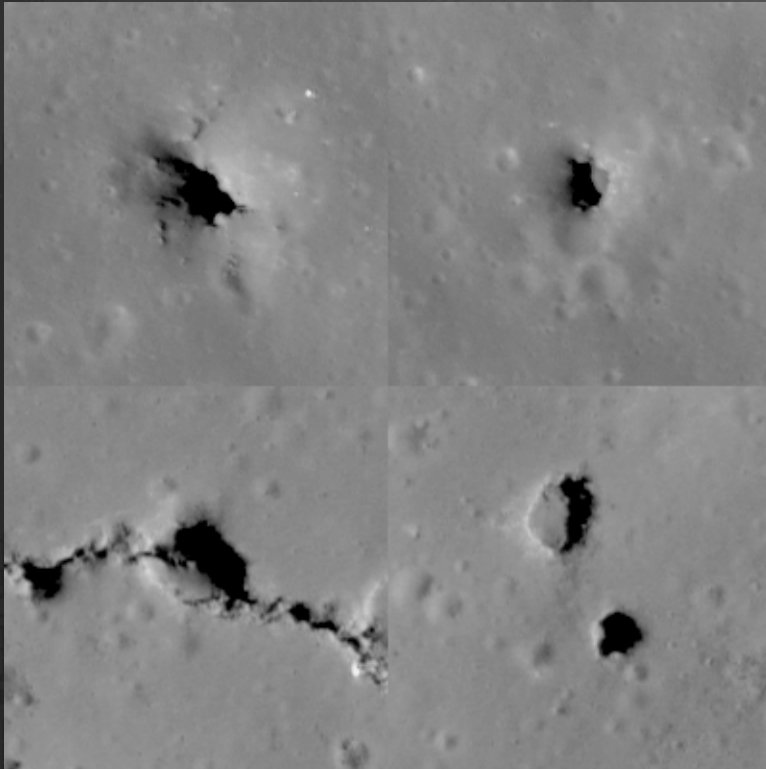
Mare Ingenii



Mare Smythii



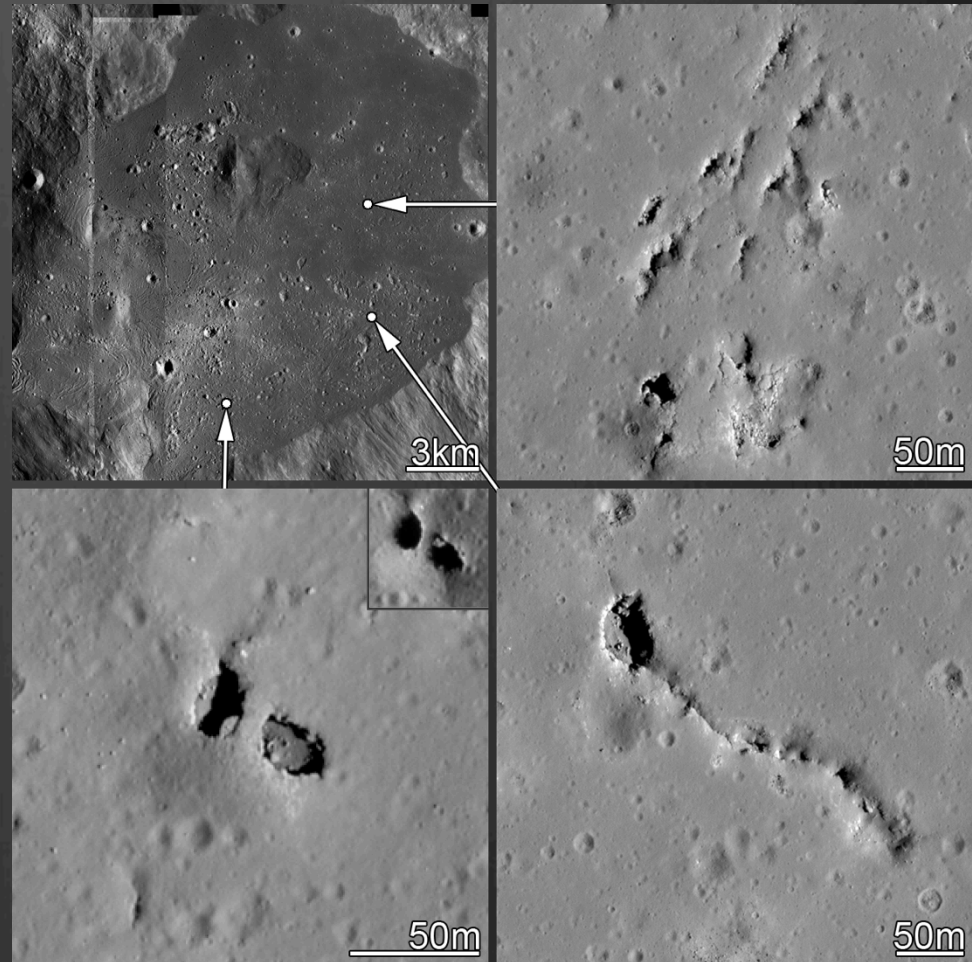
Melt Pits vs. Mare Pits



- ⊗ Impact melt pits are generally smaller and shallower (max depth 30m, median diameter 15m)
- ⊗ Impact melt pits are often irregular, where mare pits are elliptical

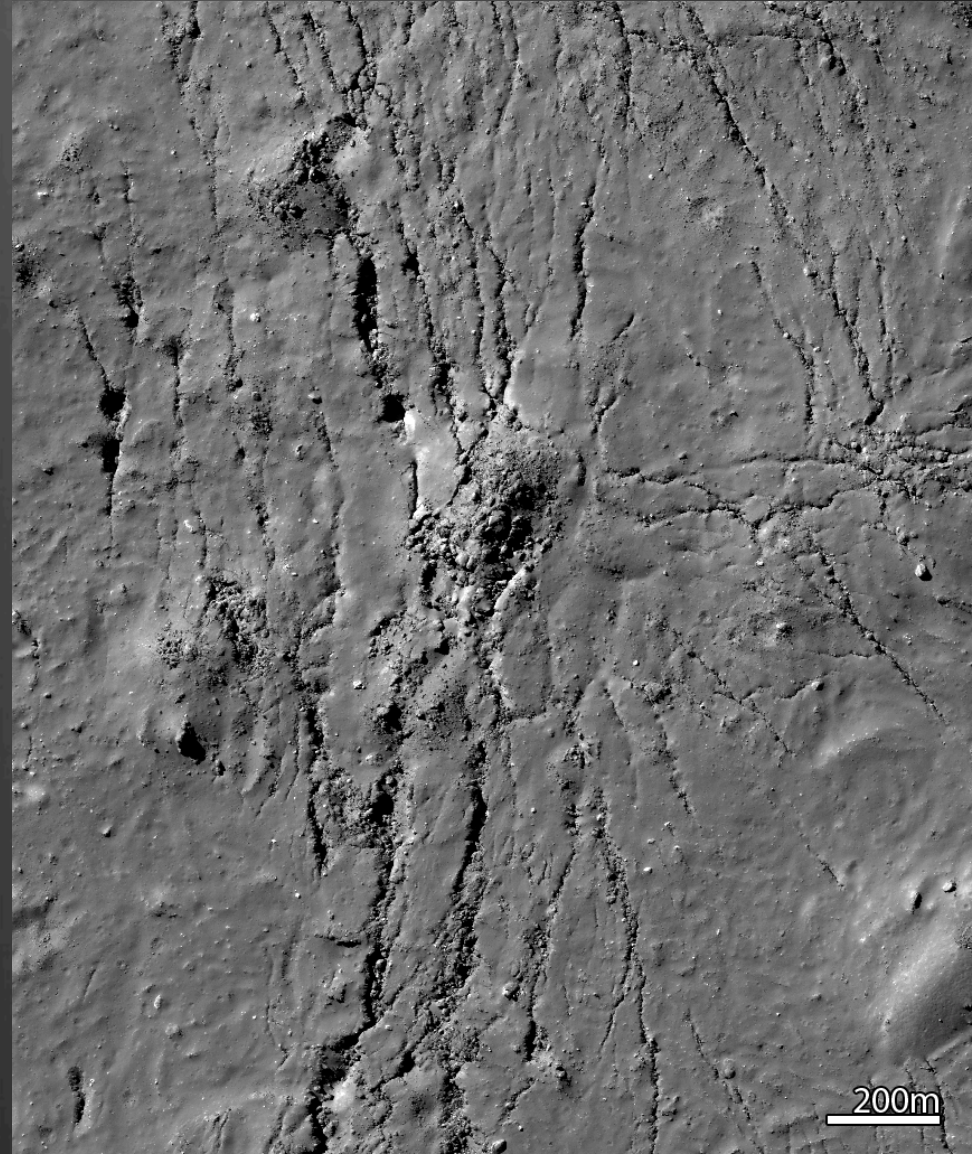
Previous Work: King Crater

- ⊗ External melt pond
- ⊗ >50 pits, 1 natural bridge
- ⊗ Detailed in Ashley 2012 (JGR) (in revision)
- ⊗ Not included here because it's an external pond, and has unusual features:
 - ⊗ km scale depressions
 - ⊗ Pits in positive relief features



Other related features

- ❁ Fractures
 - ❁ 1-5m wide, 50m->1km long
 - ❁ Likely due to cooling stress
- ❁ Rounded depressions
- ❁ Huge collapses
 - ❁ Primarily in Copernicus



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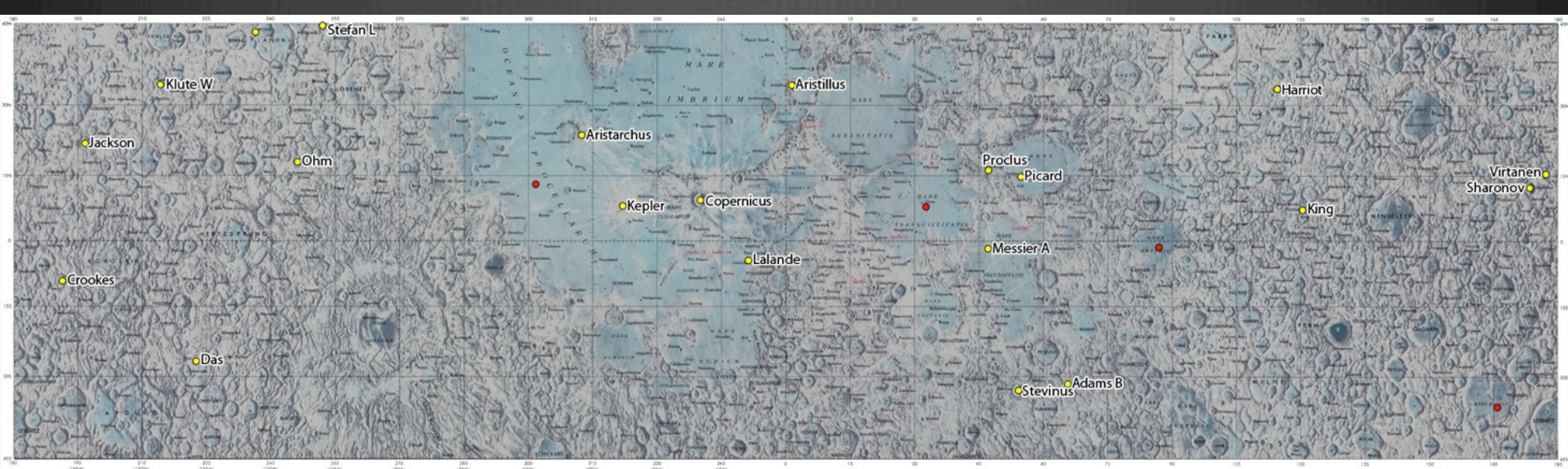


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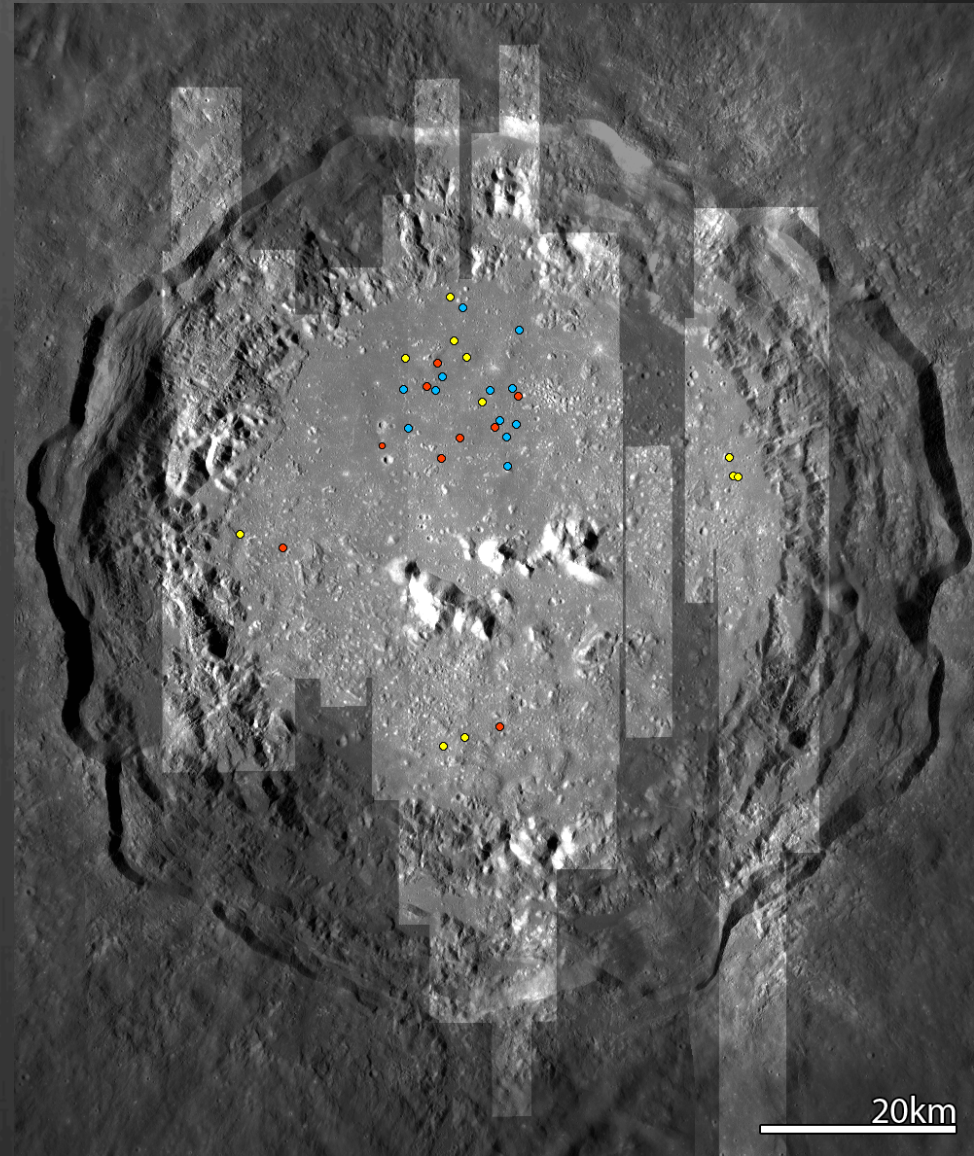
Global Distribution



- ☾ 22 Copernican and 3 Eratosthenian craters
- ☾ 80% in highland terrain
- ☾ Due to lighting restrictions, only latitudes $<45^\circ$ have been automatically searched for pits

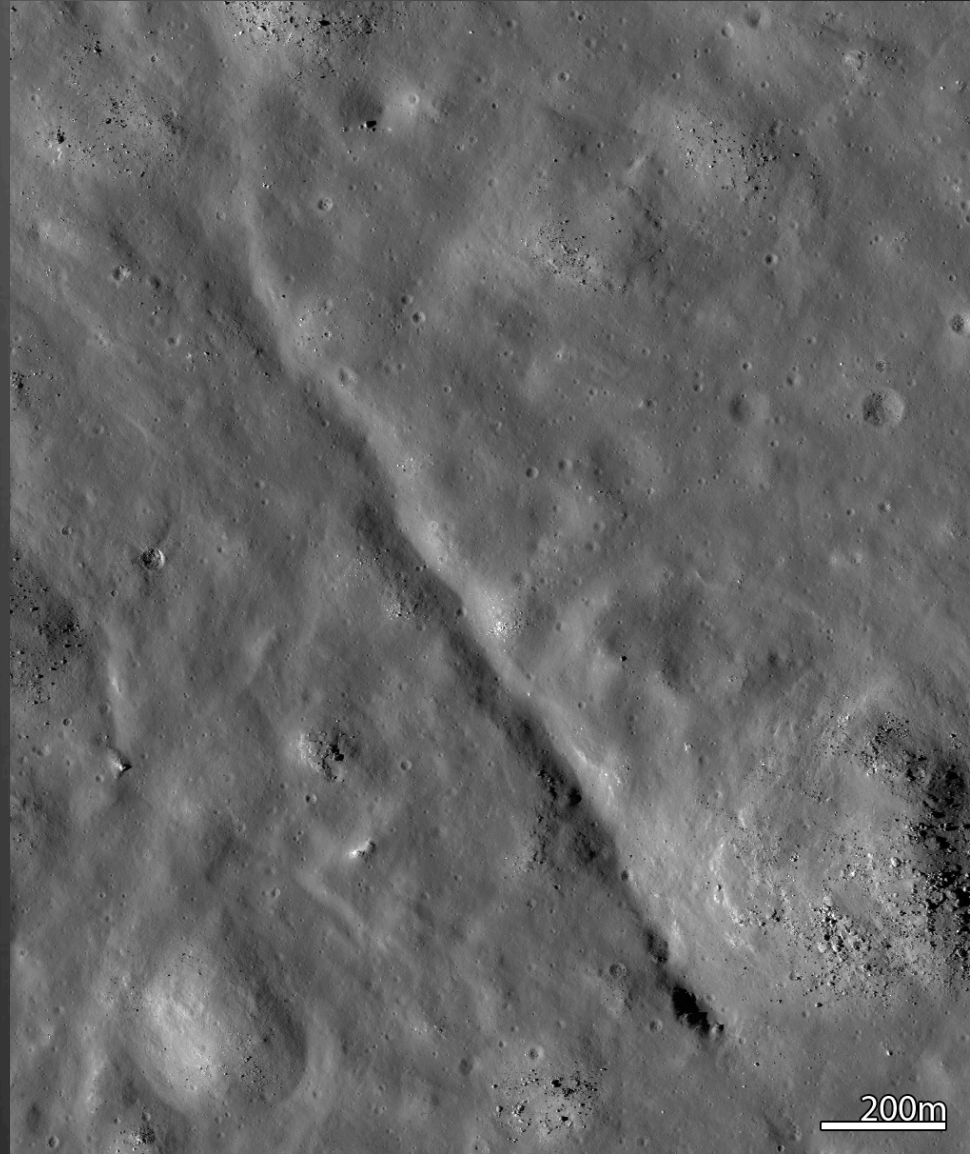
Copernicus

- Many types of features
 - Mostly unusually large
- Linear depressions
 - Can get >20m deep
 - Occasional pit chains
- Huge collapses
- Domes
 - Possibly extrusion features?
- Some stand-alone pits



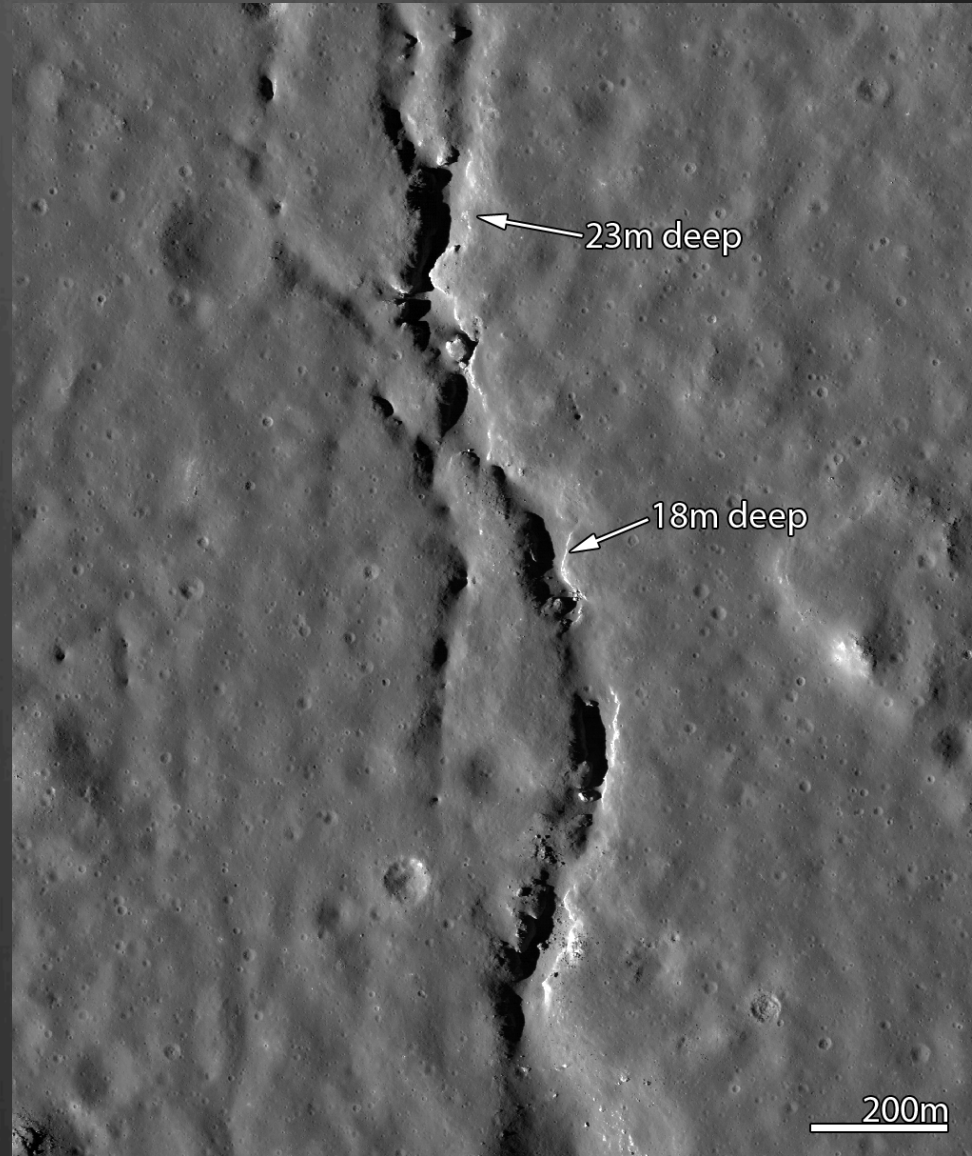
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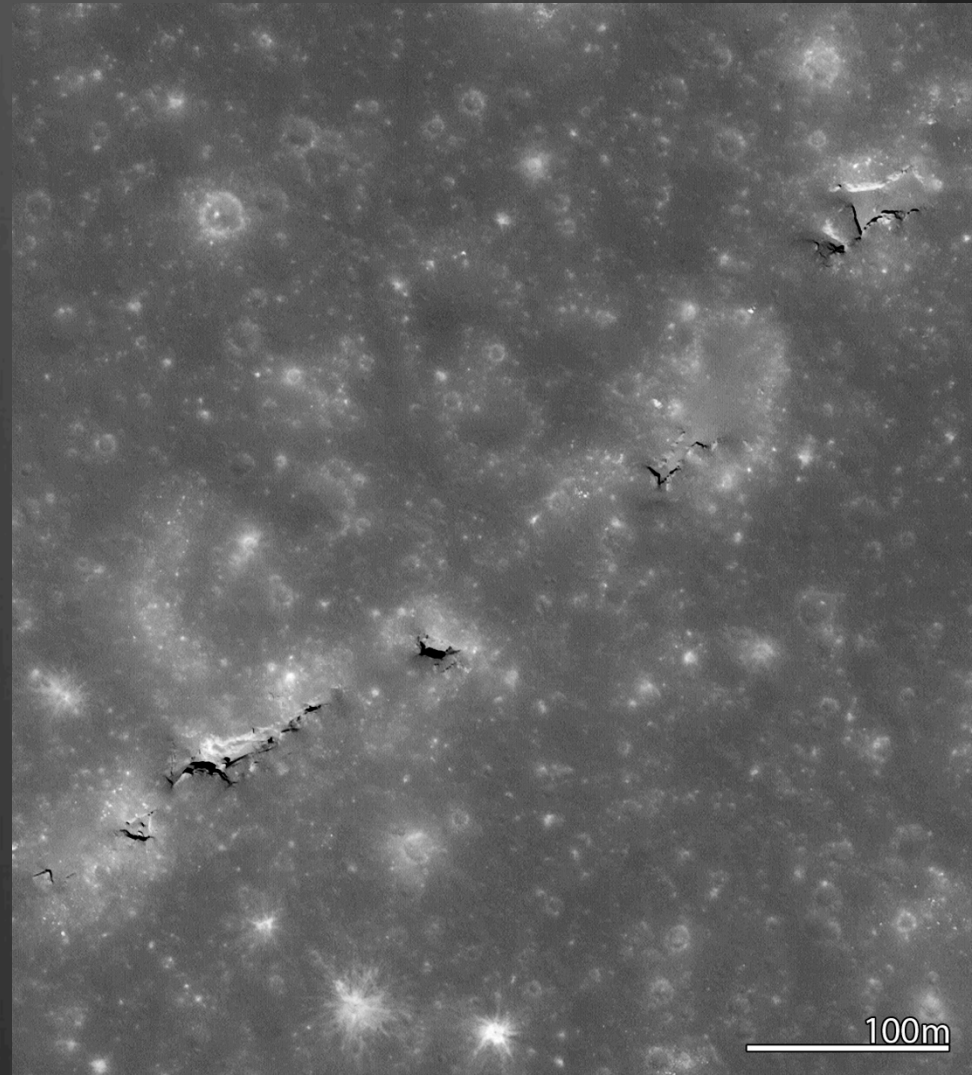
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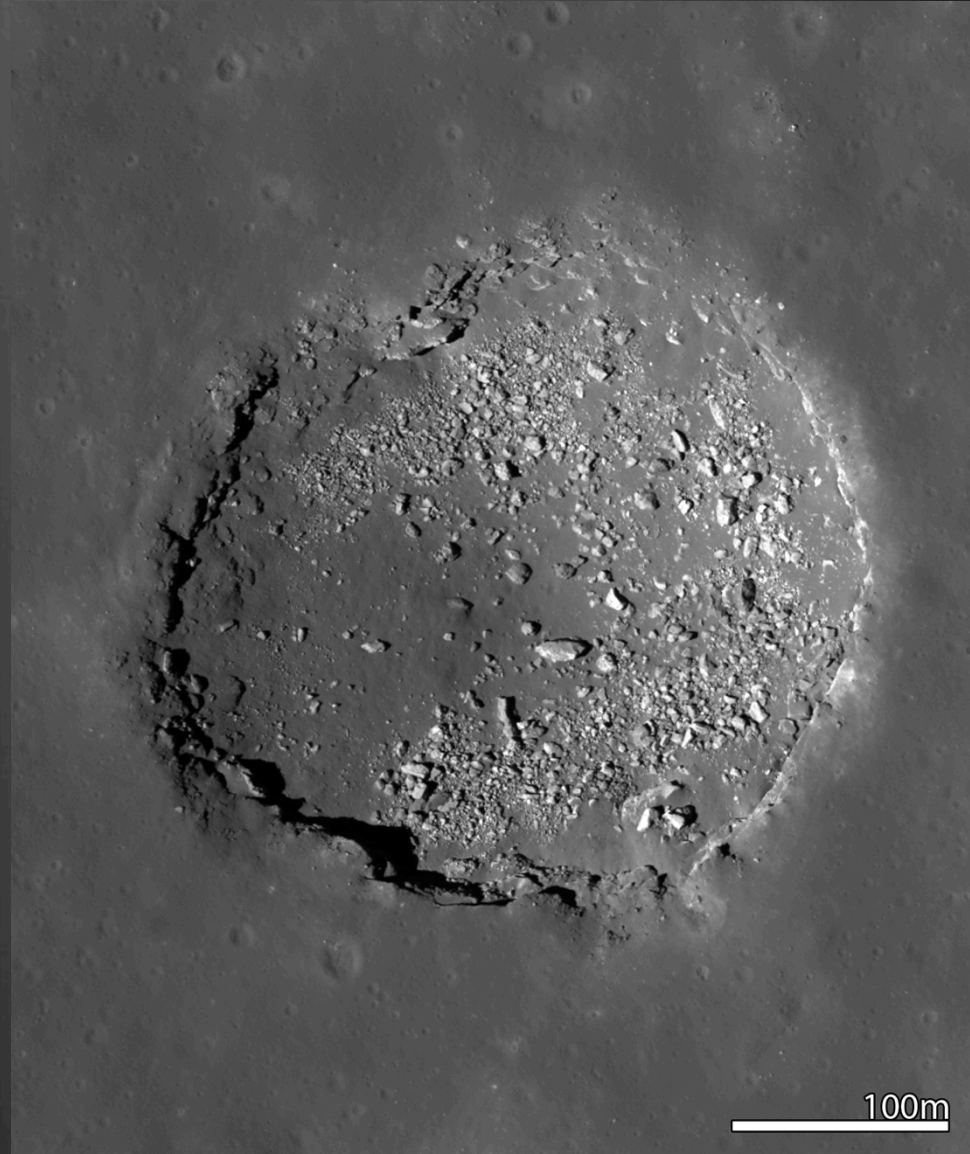
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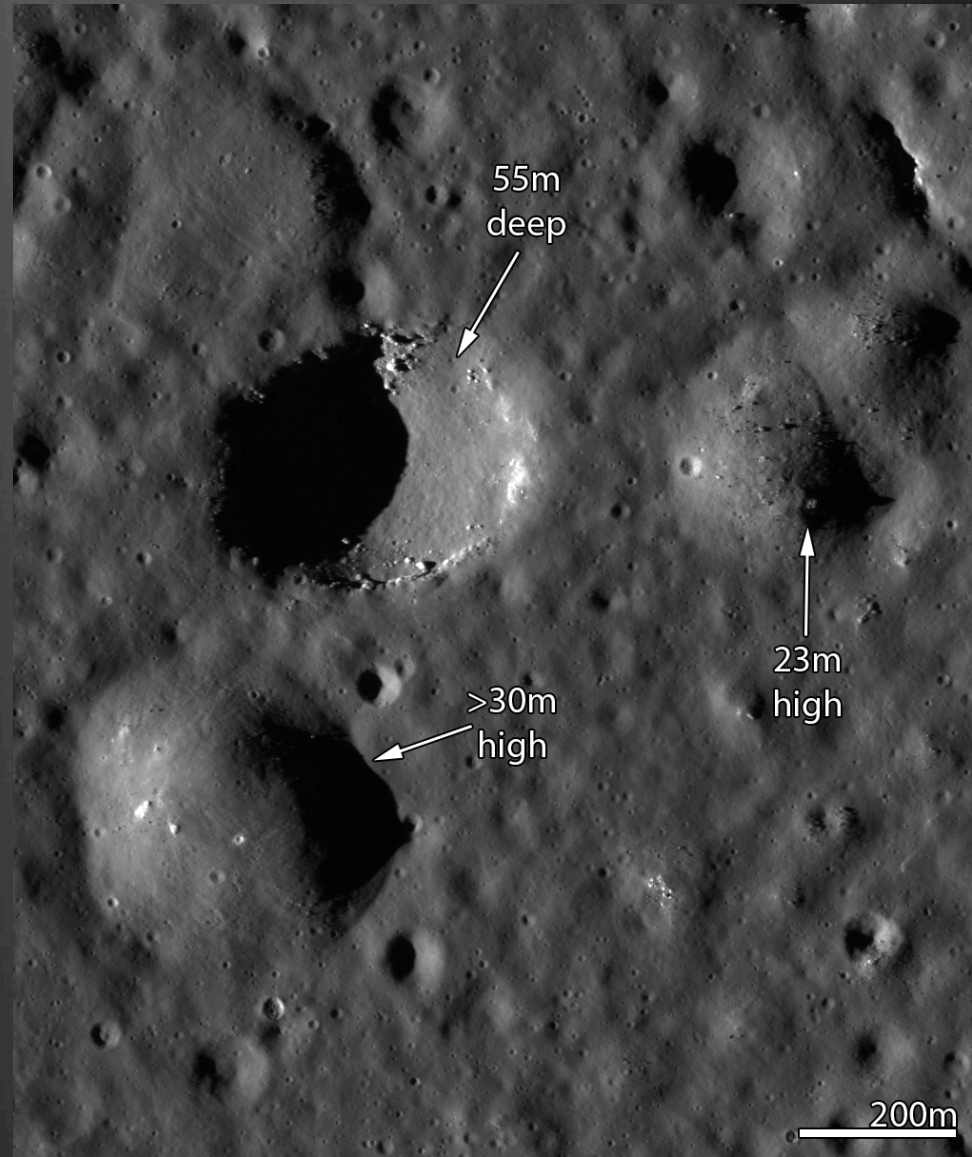
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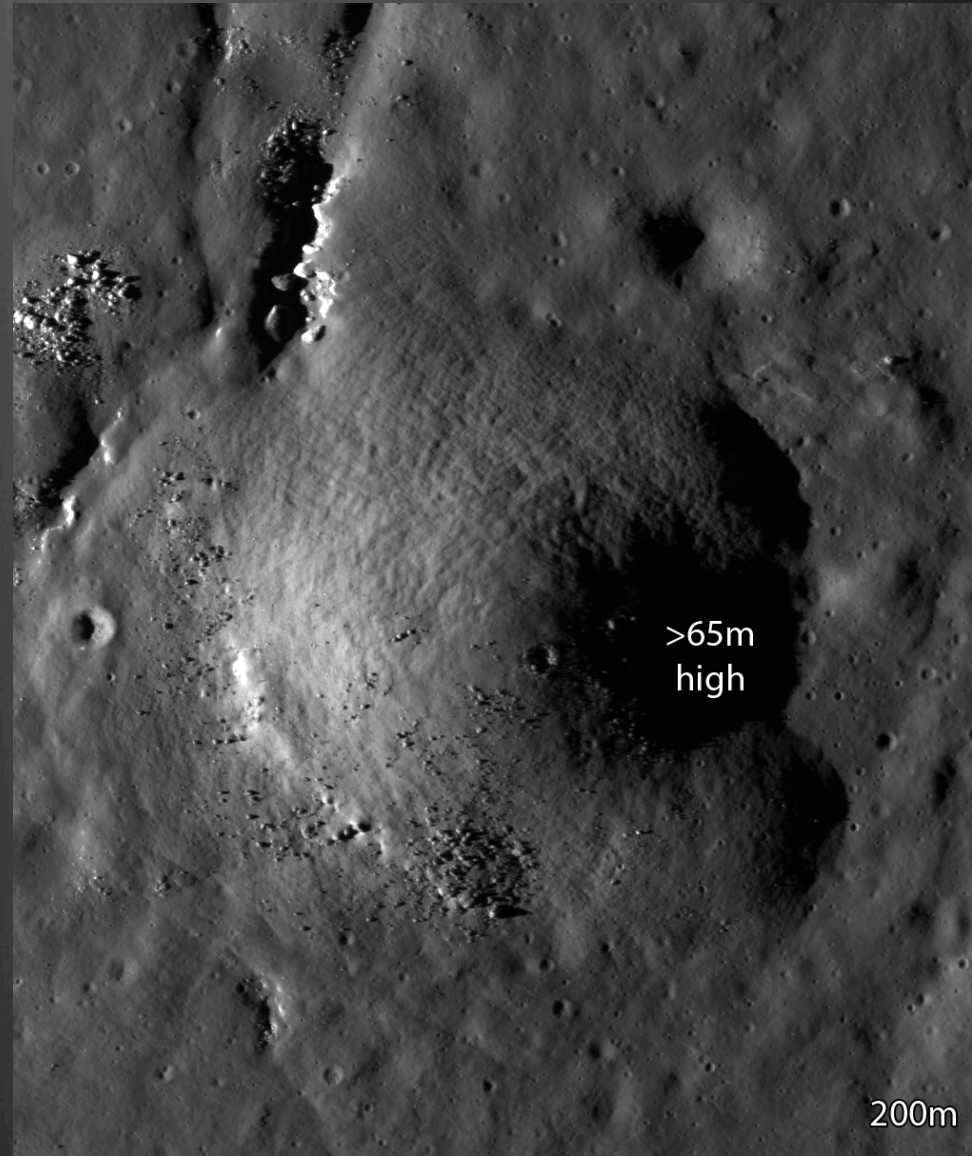
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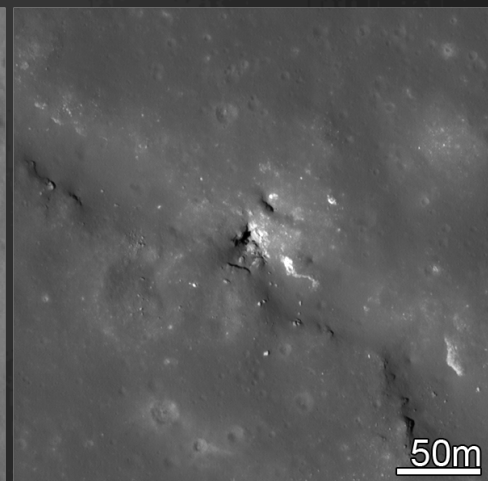
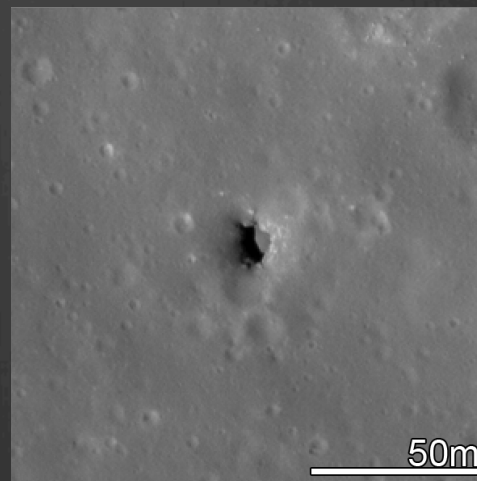
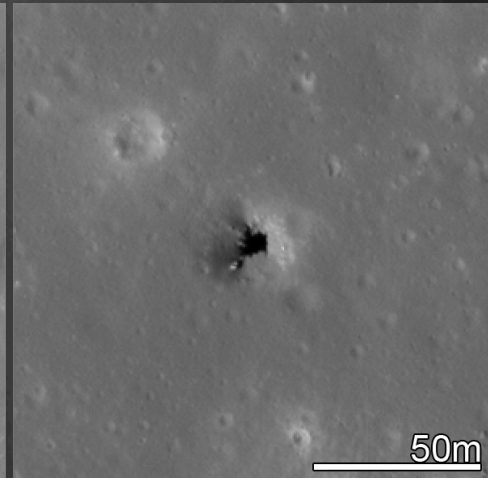
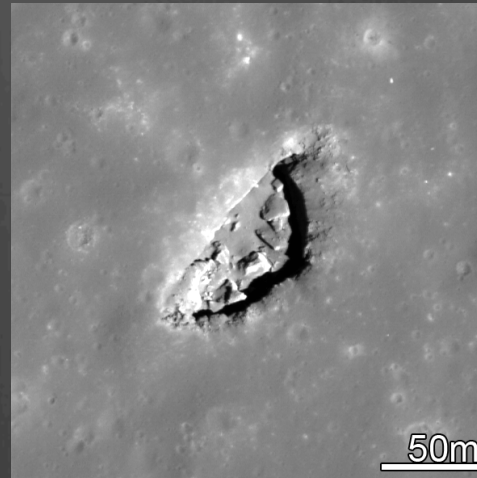
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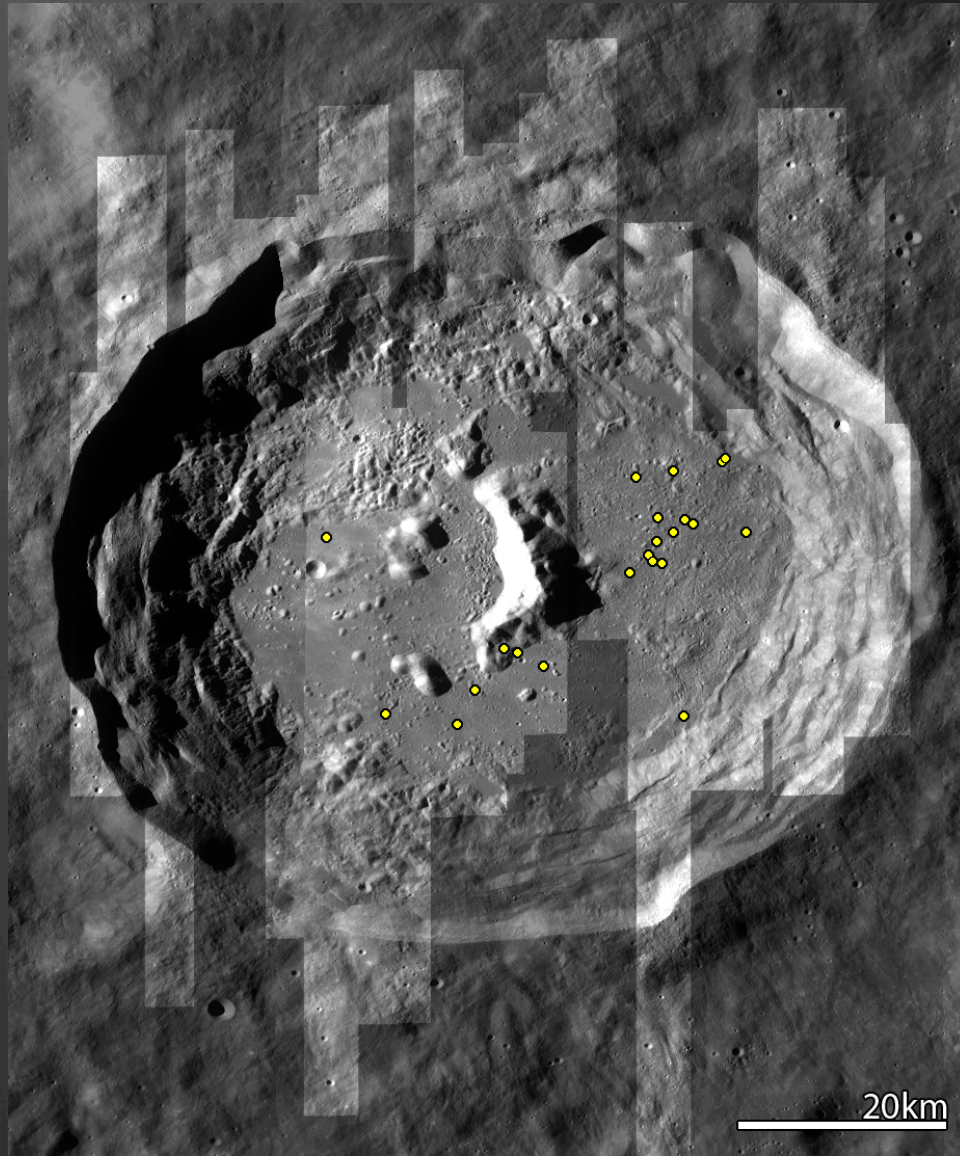
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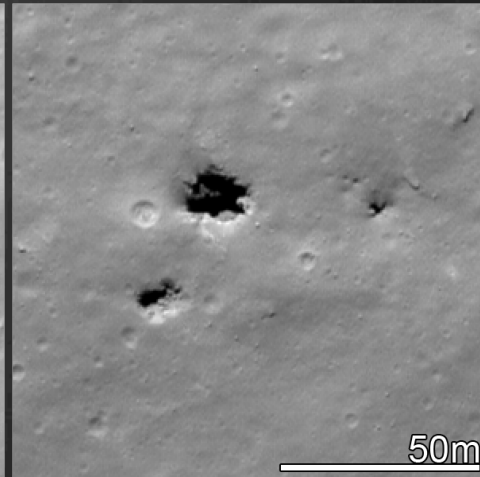
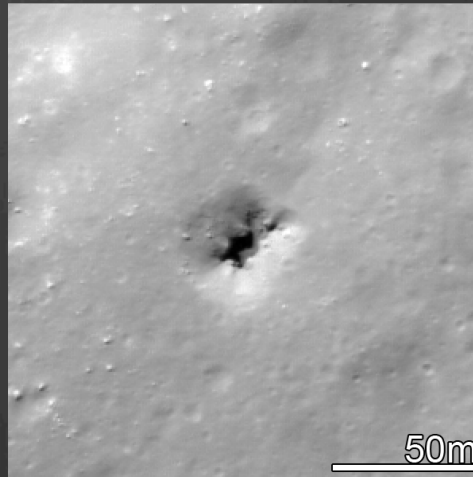
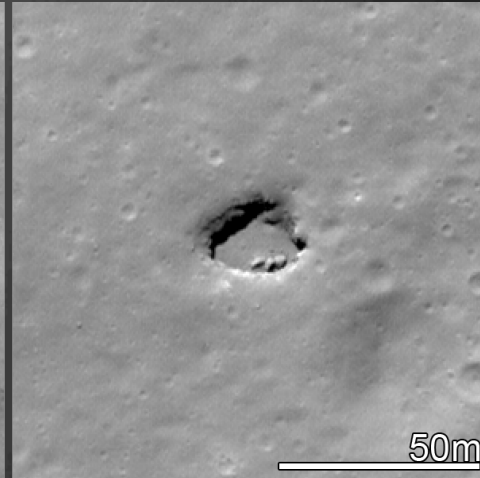
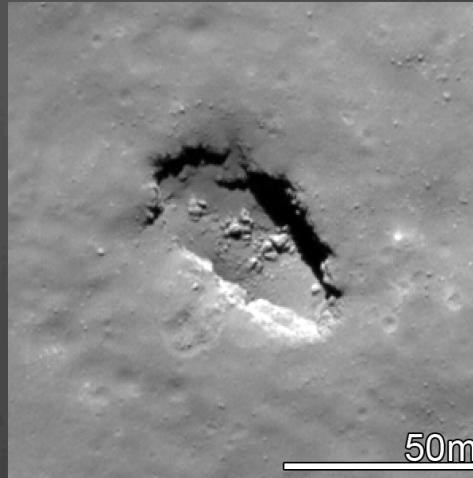
Stevinus

- ⊗ No fractures, lots of pits
- ⊗ Pits are generally average
 - ⊗ Average depth 5m
 - ⊗ Depth/diam is 0.3 to 1.1
- ⊗ Numerous “pancake domes”
 - ⊗ Flat, wide positive relief features
 - ⊗ Sometimes occur in chains



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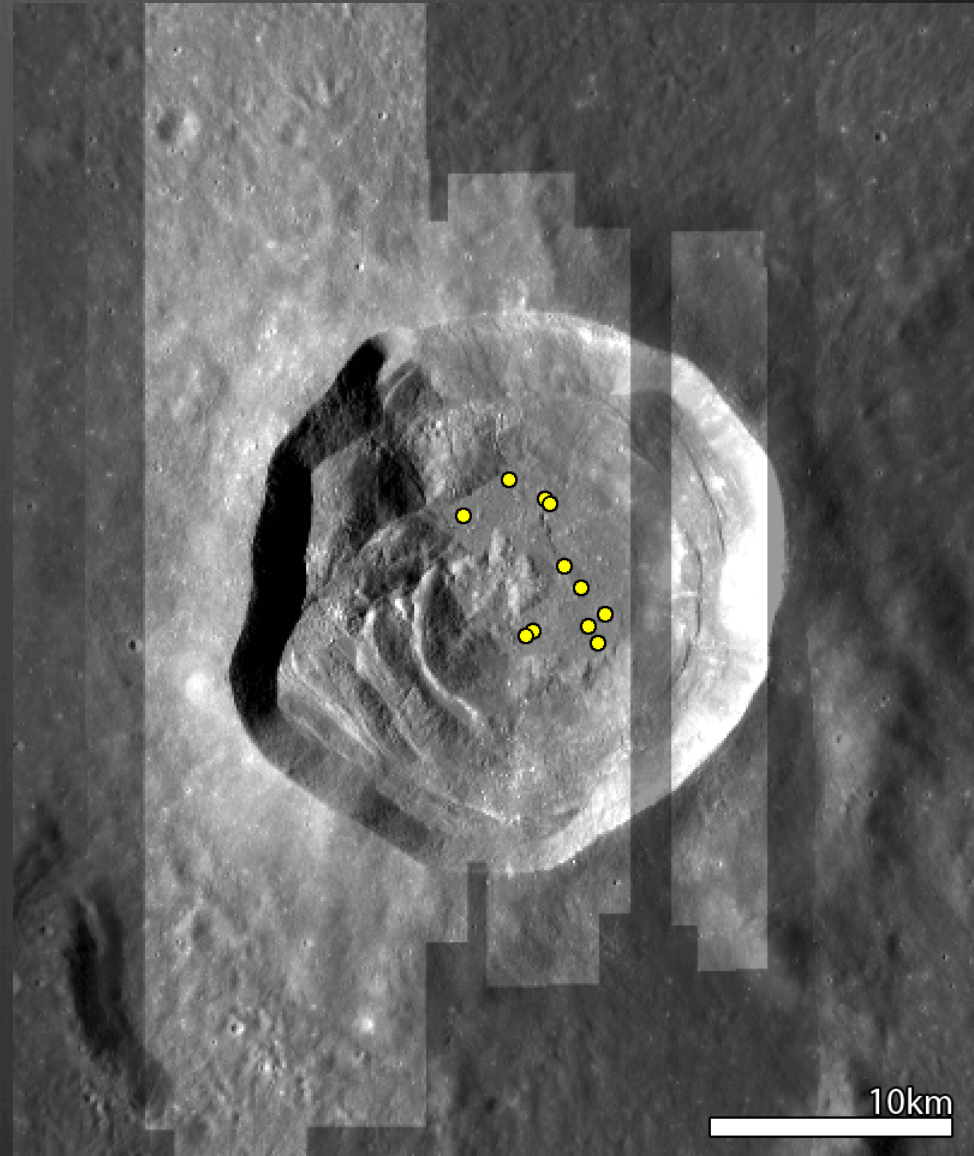
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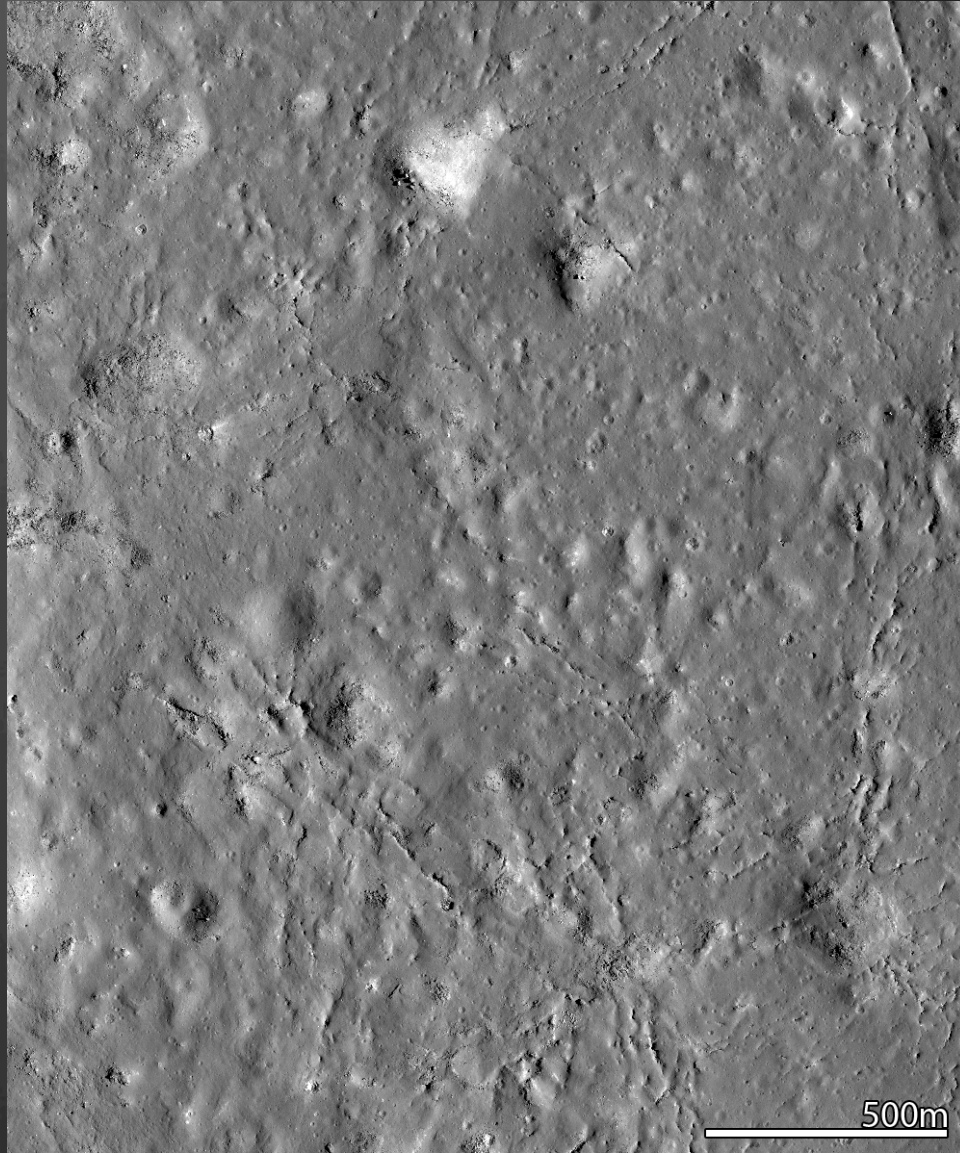
Lalande

- ❁ Melt only covers $\sim 1/2$ of floor, rest is filled with slumped material
- ❁ Floor is heavily fractured
- ❁ Also relatively densely pitted
 - ❁ Pits are generally shallow (depth/diameter < 0.6)



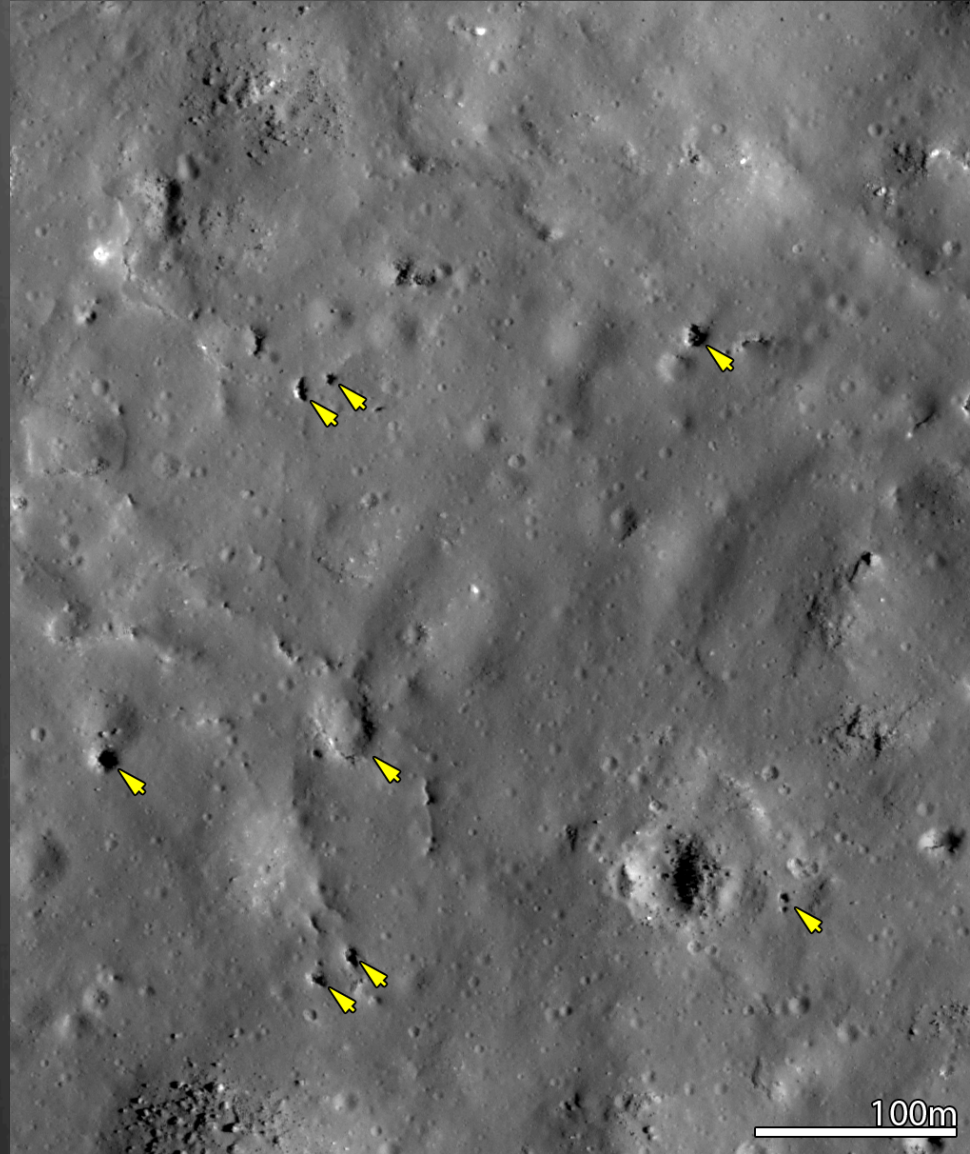
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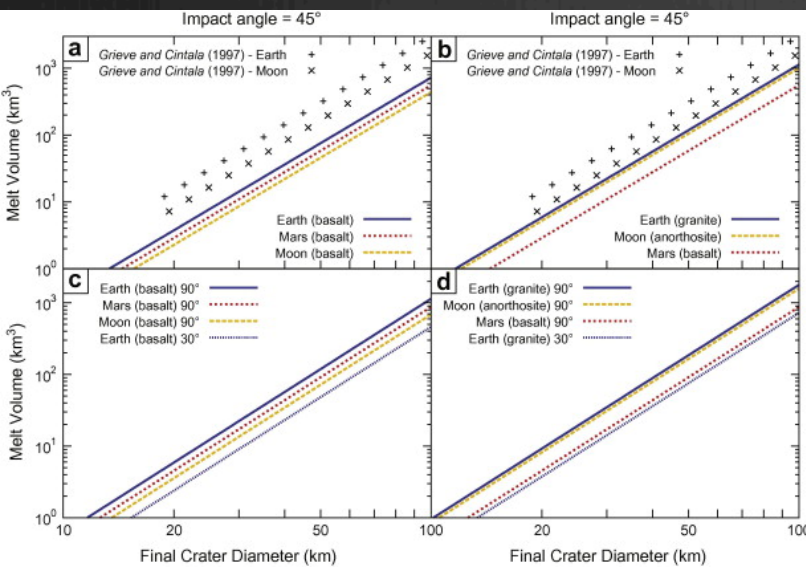
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Formation

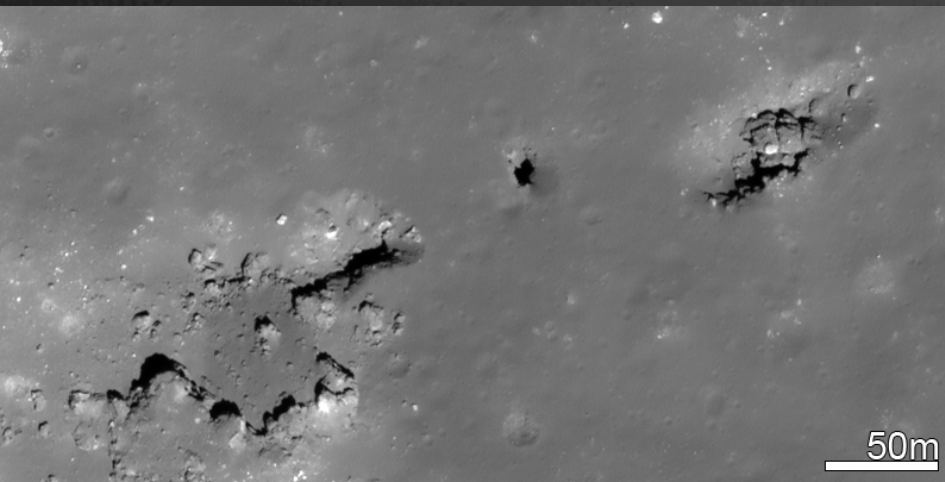
- ☉ Melt flow after the surface cools leaves void spaces
 - ☉ Possibly subsurface passages, as implied by linear depressions
- ☉ Rough estimate of average melt thickness:
 - ☉ Copernicus: 350m; Stevinus: 300m; Lalande: 150m
 - ☉ Assuming 45° impact, and that 100% of melt stays in crater



Abramov et al. (2012): Differential melt scaling for oblique impacts on terrestrial planets.

Conclusions

- ❁ Impact melt flows within deposits for significant periods of time after emplacement
- ❁ Void spaces form in impact melt deposits due to this flow
- ❁ Accessible subsurface voids allow:
 - ❁ Access to unmodified material
 - ❁ Protection for future explorers





Questions?

